Econ 311: Behavioral and Experimental Economics

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Putting the Theory to Work: Procrastination

Procrastination

- In many economic problems, agent must do a task
  - Task needs to be done exactly once
  - Agent Has several time periods to do task
- To analyze these types of decisions, use *backwards induction*: start analysis at the end of the process and work back to the first period
  - *Naive* agent is time inconsistent, but assumes self will be time-consistent in future
  - *Sophisticated* agent is time inconsistent, and knows self will be time-inconsistent in future

Procrastination Example: Setup

- Suppose student has a paper due in 4 weeks
- Can write the paper on weekend 1, 2, 3, or 4
- Cost of writing paper is missing going to movies with friends:
  - Weekend 1: bad movie, cost $= 3$
  - Weekend 2: OK movie, cost $= 5$
  - Weekend 3: good movie, cost $= 8$
  - Weekend 4: great movie, cost $= 13$
- Benefit of writing the paper is $\bar{v} > 0$, received in week 5 when grades are given
- For all types of agents, assume $\delta = 1$ in what follows
- For time-inconsistent types, assume $\beta = \frac{1}{2}$

When Does Time-Consistent Agent Write Paper?

- Proceed by *backwards induction*: start analysis at the end of the process and work back to the first period
- Week 4:
- Week 3:
- Week 2:
- Week 1:

Decision Tree

- Can be helpful to keep track of decisions of agent with a decision tree:

When Does Sophisticated Time-Inconsistent Agent Write Paper?

- *Sophisticated* agent is time inconsistent, and knows will be time-inconsistent in future
- Week 4:
- Week 3:
- Week 2:

Sophisticated Time-Inconsistent Agent, con't

- Week 1:
- Overall result:

Decision Tree for Sophisticated Agent

When Does Naive Time-Inconsistent Agent Write Paper?

- *Naive* agent is time inconsistent, but incorrectly assumes will they be time-consistent in future
- Week 4:
- Week 3:
- Week 2:

Naive Time-Inconsistent Agent, con't

- Week 1:
- Overall result:

Decision Tree for Naive Agent

Measuring Time Preferences

The Marshmallow Test: Mischel et al (1989)

- 35 preschoolers in lab, each given one marshmallow
- Told that if they can wait 15 minutes without eating marshmallow, they can get another one
- Measure how long they wait before eating marshmallow
- 12 years later, those students take the SAT
- Results:
  - Waiting time strongly positively correlated with SAT math and verbal scores
  - Waiting for 5 more minutes predict 40 points higher SAT math score

Measuring Time Preferences

- So far, evidence we have seen has not attempted to estimate either aggregate or individual time preference parameters (eg β or δ)
- General strategy in economics experiments
  - Focus on tradeoffs two time periods, say t and $t+k$
  - Try to find point where $u(c_t) = \beta^{\mathbb{I}_{t>0}}\delta^k u(c_{t+k})$
  - By varying t, allows us to estimate β and δ separately
- Several experimental methods to go about doing this
  - Willingness to pay: *State the lowest amount you'd be willing to accept today instead of $X in one month*
  - Matching: *I am indifferent between $__ today and $X in one month*
  - Multiple Price Lists: *Indicate which one you prefer: $X today or $Y in one month*

Details on Mulitple Price List Methodology

- Most commonly used experimental method
- Choices between a smaller, sooner reward and a later, larger reward
- Typically one option stays fixed will the other varies
- Point at which subject switches from smaller/sooner reward to larger/later reward helps estimate their time preference parameters

Example Multiple Price List (MPL)

List 1

Choice	Option A	Option B
1	\$100 today	\$99 in one month
2	\$100 today	\$101 in one month
3	\$100 today	\$103 in one month

List 2

Choice	Option A	Option B
1	\$100 in one month	\$99 in two months
2	\$100 in one month	\$101 in two months
3	\$100 in one month	\$103 in two months

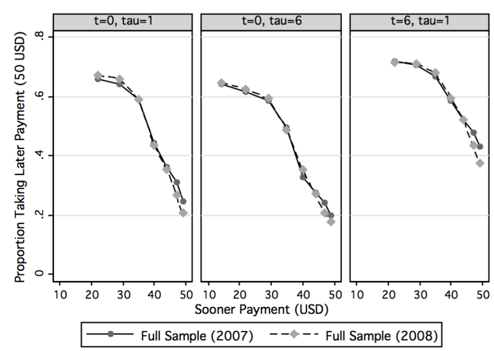
Measuring $\beta - \delta$ Preferences with MPL

- Assume for simplicity that $u(x) = x$
- Suppose you say that you are indifferent between \$100 in one month and \$Y in two months
- Then we must have $\beta\delta 100 = \beta\delta^2 Y$, which implies:
- Suppose additionally you are indifferent between \$100 today and \$X in one month
- Then we must have $100 = \beta\delta X$
- Together with the equation for δ above, this implies:

Field Evidence: Meier and Sprenger (2010)

- Give MPLs to people coming in for tax advice in Boston
- Did same procedure on same population in two different years: 2007 and 2008
- 1500 observations, including 200 people who showed up both years
- Because of setting, had access to income data
- Results:
  - Estimates of β between 0.672 and 0.792
  - Estimates of monthly δ between 0.953 and 0.981
  - Estimates remarkably stable between years

Meier and Sprenger (2010): Graphical Results



- t is early period, τ is delay length
- Note that when early reward is immediate, more likely to take early payment

Inconsistent Estimates in the Whole

- Frederick et al. (2002): Review of time preference literature
- Large variation in estimates of β from the literature as a whole

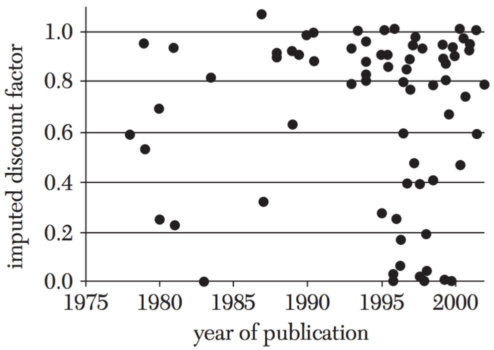


Figure 2. Discount Factor by Year of Study Publication

Potential Problems with the Standard MPL Approach

- Linearity assumption allows us to get simple formulas for parameters
  - If $u(x)$ concave, then estimates are biased
- Have assumed that transaction costs are same in all time periods
- Note we are trading off money, so subjects with access to bank accounts should be able to arbitrage if implicit interest rate in experiment is different than actual interest rate